



COVID-19

Reinfection

Clinical considerations for care of children and adults with confirmed COVID-19

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Studies suggest that reinfection with SARS-CoV-2 with the same virus variant as the initial infection or reinfection with a different variant are both possible; early reinfection within 90 days of the initial infection can occur.⁽⁹⁹⁻¹⁰¹⁾ Symptoms during reinfection are likely to be less severe than during the initial infection, but some people can experience more severe COVID-19 during reinfection.^(99,100,102,103) Both previous infection and vaccination have been shown to provide some protection against infection, although risk of reinfection varies by circulating variant⁽¹⁰⁴⁻¹⁰⁷⁾ Although rates of reinfection might change as new variants emerge, vaccination remains the safest strategy for preventing future SARS-CoV-2 infections, hospitalizations, long-term sequelae, and death. [Staying up to date](#) on primary vaccination, additional doses, and booster doses, is recommended for all eligible persons. Strategies to diagnose and treat reinfection are no different than those used to diagnose and treat initial COVID-19 infection; early testing, isolation, and treatment as indicated are recommended for all people who experience symptoms of COVID-19.

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References

1. Alene M, Yismaw L, Assemie MA, Ketema DB, Gietaneh W, Birhan TY. Serial interval and incubation period of COVID-19: a systematic review and meta-analysis. *BMC Infect Dis.* Mar 11 2021;21(1):257. doi:10.1186/s12879-021-05950-x ↗
2. Grant MC, Geoghegan L, Arbyn M, et al. The prevalence of symptoms in 24,410 adults infected by the novel coronavirus (SARS-CoV-2; COVID-19): A systematic review and meta-analysis of 148 studies from 9 countries. *PLoS One.* 2020;15(6):e0234765. doi:10.1371/journal.pone.0234765 ↗
3. Jansen L, Tegomoh B, Lange K, et al. Investigation of a SARS-CoV-2 B.1.1.529 (Omicron) Variant Cluster - Nebraska, November-December 2021. *MMWR Morb Mortal Wkly Rep.* Dec 31 2021;70(5152):1782-1784. doi:10.15585/mmwr.mm705152e3
4. Song JS, Lee J, Kim M, et al. Serial Intervals and Household Transmission of SARS-CoV-2 Omicron Variant, South Korea, 2021. *Emerging infectious diseases.* Mar 2022;28(3):756-759. doi:10.3201/eid2803.212607 ↗
5. Stokes EK, Zambrano LD, Anderson KN, et al. Coronavirus Disease 2019 Case Surveillance - United States, January 22-May 30, 2020. *MMWR Morb Mortal Wkly Rep.* Jun 19 2020;69(24):759-765. doi:10.15585/mmwr.mm6924e2
6. Roxby AC, Greninger AL, Hatfield KM, et al. Detection of SARS-CoV-2 Among Residents and Staff Members of an Independent and Assisted Living Community for Older Adults - Seattle, Washington, 2020. *MMWR Morb Mortal Wkly Rep.* Apr 10 2020;69(14):416-418. doi:10.15585/mmwr.mm6914e2
7. Kimball A, Hatfield KM, Arons M, et al. Asymptomatic and Presymptomatic SARS-CoV-2 Infections in Residents of a Long-Term Care Skilled Nursing Facility - King County, Washington, March 2020. *MMWR Morb Mortal Wkly Rep.* Apr 3 2020;69(13):377-381. doi:10.15585/mmwr.mm6913e1
8. Sheehan MM, Reddy AJ, Rothberg MB. Reinfection Rates Among Patients Who Previously Tested Positive for Coronavirus Disease 2019: A Retrospective Cohort Study. *Clinical Infectious Diseases.* 2021;73(10):1882-1886. doi:10.1093/cid/ciab234 ↗
9. Kronbichler A, Kresse D, Yoon S, Lee KH, Effenberger M, Shin JI. Asymptomatic patients as a source of COVID-19 infections: A systematic review and meta-analysis. *International Journal of Infectious Diseases.* 2020/09/01/2020;98:180-186. doi:https://doi.org/10.1016/j.ijid.2020.06.052 ↗
10. Yang J, Zheng Y, Gou X, et al. Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. *Int J Infect Dis.* May 2020;94:91-95. doi:10.1016/j.ijid.2020.03.017 ↗
11. Tenforde MW, Billig Rose E, Lindsell CJ, et al. Characteristics of Adult Outpatients and Inpatients with COVID-19 - 11 Academic Medical Centers, United States, March-May 2020. *MMWR Morb Mortal Wkly Rep.* Jul 3 2020;69(26):841-846. doi:10.15585/mmwr.mm6926e3
12. Clifford CT, Pour TR, Freeman R, et al. Association between COVID-19 diagnosis and presenting chief complaint from New York City triage data. *The American Journal of Emergency Medicine.* 2021/08/01/ 2021;46:520-524. doi:https://doi.org/10.1016/j.ajem.2020.11.006 ↗
13. Nasiri N, Sharifi H, Bazrafshan A, Noori A, Karamouzian M, Sharifi A. Ocular Manifestations of COVID-19: A Systematic Review and Meta-analysis. *J Ophthalmic Vis Res.* Jan-Mar 2021;16(1):103-112. doi:10.18502/jovr.v16i1.8256 ↗
14. Tan E, Song J, Deane AM, Plummer MP. Global Impact of Coronavirus Disease 2019 Infection Requiring Admission to the ICU: A Systematic Review and Meta-analysis. *Chest.* 2021/02/01/ 2021;159(2):524-536. doi:https://doi.org/10.1016/j.chest.2020.10.014 ↗
15. Genovese G, Moltrasio C, Berti E, Marzano AV. Skin Manifestations Associated with COVID-19: Current Knowledge and Future Perspectives. *Dermatology.* 2021;237(1):1-12. doi:10.1159/000512932 ↗
16. Thompson HA, Mousa A, Dighe A, et al. SARS-CoV-2 setting-specific transmission rates: a systematic review and meta-analysis. *Clin Infect Dis.* Feb 9 2021;doi:10.1093/cid/ciab100 ↗
17. Singanayagam A, Patel M, Charlett A, et al. Duration of infectiousness and correlation with RT-PCR cycle threshold values in cases of COVID-19, England, January to May 2020. *Euro Surveill.* Aug 2020;25(32)doi:10.2807/1560-7917.Es.2020.25.32.2001483 ↗
18. Eyre DW, Taylor D, Purver M, et al. Effect of Covid-19 Vaccination on Transmission of Alpha and Delta Variants. *New England Journal of Medicine.* 2022;386(8):744-756. doi:10.1056/NEJMoa2116597 ↗
19. Lansbury L, Lim B, Baskaran V, Lim WS. Co-infections in people with COVID-19: a systematic review and meta-analysis. *Journal of Infection.* 2020/08/01/ 2020;81(2):266-275. doi:https://doi.org/10.1016/j.jinf.2020.05.046 ↗

20. Gerver SM, Guy R, Wilson K, et al. National surveillance of bacterial and fungal coinfection and secondary infection in COVID-19 patients in England: lessons from the first wave. *Clinical Microbiology and Infection*. 2021;11/01/2021;27(11):1658-1665. doi:<https://doi.org/10.1016/j.cmi.2021.05.040> ↗
21. Chandler CM, Reid MC, Cherian S, Sabath DE, Edlefsen KL. Comparison of Blood Counts and Markers of Inflammation and Coagulation in Patients With and Without COVID-19 Presenting to the Emergency Department in Seattle, WA. *American Journal of Clinical Pathology*. 2021;156(2):185-197. doi:10.1093/ajcp/aqab052 ↗
22. Levi M, Thachil J, Iba T, Levy JH. Coagulation abnormalities and thrombosis in patients with COVID-19. *The Lancet Haematology*. 2020/06/01/ 2020;7(6):e438-e440. doi:[https://doi.org/10.1016/S2352-3026\(20\)30145-9](https://doi.org/10.1016/S2352-3026(20)30145-9) ↗
23. Sadiq Z, Rana S, Mahfoud Z, Raoof A. Systematic review and meta-analysis of chest radiograph (CXR) findings in COVID-19. *Clinical Imaging*. 2021/12/01/ 2021;80:229-238. doi:<https://doi.org/10.1016/j.clinimag.2021.06.039> ↗
24. Kanne JP, Bai H, Bernheim A, et al. COVID-19 Imaging: What We Know Now and What Remains Unknown. *Radiology*. 2021;299(3):E262-E279. doi:10.1148/radiol.2021204522 ↗
25. Doerschug KC, Schmidt GA. Pulmonary Aspects of COVID-19. *Annual Review of Medicine*. 2022;73(1):81-93. doi:10.1146/annurev-med-042220-014817 ↗
26. Bhaskaran K, Bacon S, Evans SJ, et al. Factors associated with deaths due to COVID-19 versus other causes: population-based cohort analysis of UK primary care data and linked national death registrations within the OpenSAFELY platform. *Lancet Reg Health Eur*. Jul 2021;6:100109. doi:10.1016/j.lanepe.2021.100109 ↗
27. Kim L, Garg S, O'Halloran A, et al. Risk Factors for Intensive Care Unit Admission and In-hospital Mortality among Hospitalized Adults Identified through the U.S. Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET). *Clin Infect Dis*. Jul 16 2020;doi:10.1093/cid/ciaa1012 ↗
28. Kompaniyets L, Pennington AF, Goodman AB, et al. Underlying Medical Conditions and Severe Illness Among 540,667 Adults Hospitalized With COVID-19, March 2020-March 2021. *Preventing chronic disease*. Jul 1 2021;18:E66. doi:10.5888/pcd18.210123 ↗
29. Ko JY, Danielson ML, Town M, et al. Risk Factors for Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization: COVID-19-Associated Hospitalization Surveillance Network and Behavioral Risk Factor Surveillance System. *Clinical Infectious Diseases*. 2020; ↗
30. Wortham JM, Lee JT, Althomsons S, et al. Characteristics of Persons Who Died with COVID-19 - United States, February 12-May 18, 2020. *MMWR Morb Mortal Wkly Rep*. Jul 17 2020;69(28):923-929. doi:10.15585/mmwr.mm6928e1 ↗
31. Yang X, Zhang J, Chen S, et al. Demographic Disparities in Clinical Outcomes of COVID-19: Data From a Statewide Cohort in South Carolina. *Open Forum Infect Dis*. Sep 2021;8(9):ofab428. doi:10.1093/ofid/ofab428 ↗
32. Rader B, Gertz A, Iuliano AD, et al. Use of At-Home COVID-19 Tests - United States, August 23, 2021-March 12, 2022. *MMWR Morb Mortal Wkly Rep*. Apr 1 2022;71(13):489-494. doi:10.15585/mmwr.mm7113e1
33. Pingali C, Meghani M, Razzaghi H, et al. COVID-19 Vaccination Coverage Among Insured Persons Aged >/=16 Years, by Race/Ethnicity and Other Selected Characteristics - Eight Integrated Health Care Organizations, United States, December 14, 2020-May 15, 2021. *MMWR Morb Mortal Wkly Rep*. Jul 16 2021;70(28):985-990. doi:10.15585/mmwr.mm7028a1
34. Wiltz JL, Feehan AK, Molinari NM, et al. Racial and Ethnic Disparities in Receipt of Medications for Treatment of COVID-19 - United States, March 2020-August 2021. *MMWR Morb Mortal Wkly Rep*. Jan 21 2022;71(3):96-102. doi:10.15585/mmwr.mm7103e1
35. Murthy NC, Zell E, Fast HE, et al. Disparities in First Dose COVID-19 Vaccination Coverage among Children 5-11 Years of Age, United States. *Emerging infectious diseases*. May 2022;28(5):986-989. doi:10.3201/eid2805.220166 ↗
36. Saelee R, Zell E, Murthy BP, et al. Disparities in COVID-19 Vaccination Coverage Between Urban and Rural Counties - United States, December 14, 2020-January 31, 2022. *MMWR Morb Mortal Wkly Rep*. Mar 4 2022;71(9):335-340. doi:10.15585/mmwr.mm7109a2
37. Burki TK. The role of antiviral treatment in the COVID-19 pandemic. *The Lancet Respiratory Medicine*. 2022/02/01/ 2022;10(2):e18. doi:[https://doi.org/10.1016/S2213-2600\(22\)00011-X](https://doi.org/10.1016/S2213-2600(22)00011-X) ↗
38. Jayk Bernal A, Gomes da Silva MM, Musungaie DB, et al. Molnupiravir for Oral Treatment of Covid-19 in Nonhospitalized Patients. *New England Journal of Medicine*. 2021;386(6):509-520. doi:10.1056/NEJMoa2116044 ↗
39. Sjoding MW, Dickson RP, Iwashyna TJ, Gay SE, Valley TS. Racial Bias in Pulse Oximetry Measurement. *New England Journal of Medicine*. 2020;383(25):2477-2478. doi:10.1056/NEJMc2029240 ↗

40. Jordan TB, Meyers CL, Schrading WA, Donnelly JP. The utility of iPhone oximetry apps: A comparison with standard pulse oximetry measurement in the emergency department. *Am J Emerg Med*. May 2020;38(5):925-928. doi:10.1016/j.ajem.2019.07.020 ↗
41. Iuliano AD, Brunkard JM, Boehmer TK, et al. Trends in disease severity and health care utilization during the early omicron variant period compared with previous SARS-CoV-2 high transmission periods — United States, December 2020–January 2022. Journal Article. 2022;71MMWR. Morbidity and mortality weekly report ; v. 71, early release, January 25, 2022.
42. Taylor CA, Whitaker M, Anglin O, et al. COVID-19-Associated Hospitalizations Among Adults During SARS-CoV-2 Delta and Omicron Variant Predominance, by Race/Ethnicity and Vaccination Status - COVID-NET, 14 States, July 2021-January 2022. *MMWR Morb Mortal Wkly Rep*. Mar 25 2022;71(12):466-473. doi:10.15585/mmwr.mm7112e2
43. Johnson AG, Amin AB, Ali AR, et al. COVID-19 Incidence and Death Rates Among Unvaccinated and Fully Vaccinated Adults with and Without Booster Doses During Periods of Delta and Omicron Variant Emergence - 25 U.S. Jurisdictions, April 4-December 25, 2021. *MMWR Morb Mortal Wkly Rep*. Jan 28 2022;71(4):132-138. doi:10.15585/mmwr.mm7104e2
44. Danza P, Koo TH, Haddix M, et al. SARS-CoV-2 Infection and Hospitalization Among Adults Aged >/=18 Years, by Vaccination Status, Before and During SARS-CoV-2 B.1.1.529 (Omicron) Variant Predominance - Los Angeles County, California, November 7, 2021-January 8, 2022. *MMWR Morb Mortal Wkly Rep*. Feb 4 2022;71(5):177-181. doi:10.15585/mmwr.mm7105e1
45. Zambrano LD, Ellington S, Strid P, et al. Update: Characteristics of Symptomatic Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status - United States, January 22-October 3, 2020. *MMWR Morb Mortal Wkly Rep*. Nov 6 2020;69(44):1641-1647. doi:10.15585/mmwr.mm6944e3
46. Jamieson DJ, Rasmussen SA. An update on COVID-19 and pregnancy. *American Journal of Obstetrics and Gynecology*. 2022/02/01 / 2022;226(2):177-186. doi:https://doi.org/10.1016/j.ajog.2021.08.054 ↗
47. Barbero P, Muguerza L, Herraiz I, et al. SARS-CoV-2 in pregnancy: characteristics and outcomes of hospitalized and non-hospitalized women due to COVID-19. *The Journal of Maternal-Fetal & Neonatal Medicine*. 2020;1-7. doi:10.1080/14767058.2020.1793320 ↗
48. Grechukhina O, Greenberg V, Lundsberg LS, et al. Coronavirus disease 2019 pregnancy outcomes in a racially and ethnically diverse population. *American Journal of Obstetrics & Gynecology MFM*. 2020/11/01 / 2020;2(4, Supplement):100246. doi:https://doi.org/10.1016/j.ajogmf.2020.100246 ↗
49. Galang RR, Newton SM, Woodworth KR, et al. Risk factors for illness severity among pregnant women with confirmed SARS-CoV-2 infection – Surveillance for Emerging Threats to Mothers and Babies Network, 20 state, local, and territorial health departments, March 29, 2020 -January 8, 2021. *medRxiv*. 2021:2021.02.27.21252169. doi:10.1101/2021.02.27.21252169 ↗
50. Jering KS, Claggett BL, Cunningham JW, et al. Clinical Characteristics and Outcomes of Hospitalized Women Giving Birth With and Without COVID-19. *JAMA Intern Med*. Jan 15 2021;doi:10.1001/jamainternmed.2020.9241 ↗
51. Matar R, Alrahmani L, Monzer N, et al. Clinical Presentation and Outcomes of Pregnant Women With Coronavirus Disease 2019: A Systematic Review and Meta-analysis. *Clin Infect Dis*. Feb 1 2021;72(3):521-533. doi:10.1093/cid/ciaa828 ↗
52. Dubey P, Thakur B, Reddy S, et al. Current trends and geographical differences in therapeutic profile and outcomes of COVID-19 among pregnant women - a systematic review and meta-analysis. *BMC Pregnancy Childbirth*. Mar 24 2021;21(1):247. doi:10.1186/s12884-021-03685-w ↗
53. Wei SQ, Bilodeau-Bertrand M, Liu S, Auger N. The impact of COVID-19 on pregnancy outcomes: a systematic review and meta-analysis. *Cmaj*. Apr 19 2021;193(16):E540-e548. doi:10.1503/cmaj.202604 ↗
54. Allotey J, Stallings E, Bonet M, et al. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. *BMJ (Clinical research ed)*. Sep 1 2020;370:m3320. doi:10.1136/bmj.m3320 ↗
55. DeSisto CL, Wallace B, Simeone RM, et al. Risk for Stillbirth Among Women With and Without COVID-19 at Delivery Hospitalization - United States, March 2020-September 2021. *MMWR Morb Mortal Wkly Rep*. Nov 26 2021;70(47):1640-1645. doi:10.15585/mmwr.mm7047e1
56. Ko JY, Danielson ML, Town M, et al. Risk Factors for COVID-19-associated hospitalization: COVID-19-Associated Hospitalization Surveillance Network and Behavioral Risk Factor Surveillance System. *Clin Infect Dis*. Sep 18 2020;doi:10.1093/cid/ciaa1419 ↗

57. Hcini N, Maamri F, Picone O, et al. Maternal, fetal and neonatal outcomes of large series of SARS-CoV-2 positive pregnancies in peripartum period: A single-center prospective comparative study. *Eur J Obstet Gynecol Reprod Biol.* Feb 2021;257:11-18. doi:10.1016/j.ejogrb.2020.11.068 ↗
58. Prabhu M, Cagino K, Matthews KC, et al. Pregnancy and postpartum outcomes in a universally tested population for SARS-CoV-2 in New York City: a prospective cohort study. *Bjog.* Nov 2020;127(12):1548-1556. doi:10.1111/1471-0528.16403 ↗
59. Siebach MK, Piedimonte G, Ley SH. COVID-19 in childhood: Transmission, clinical presentation, complications and risk factors. *Pediatric Pulmonology.* 2021;56(6):1342-1356. doi:https://doi.org/10.1002/ppul.25344 ↗
60. Rubens JH, Akindele NP, Tschudy MM, Sick-Samuels AC. Acute covid-19 and multisystem inflammatory syndrome in children. *BMJ (Clinical research ed).* 2021;372:n385. doi:10.1136/bmj.n385 ↗
61. Martin B, DeWitt PE, Russell S, et al. Characteristics, Outcomes, and Severity Risk Factors Associated With SARS-CoV-2 Infection Among Children in the US National COVID Cohort Collaborative. *JAMA Network Open.* 2022;5(2):e2143151-e2143151. doi:10.1001/jamanetworkopen.2021.43151 ↗
62. Kompaniyets L, Agathis NT, Nelson JM, et al. Underlying Medical Conditions Associated With Severe COVID-19 Illness Among Children. *JAMA Network Open.* 2021;4(6):e2111182-e2111182. doi:10.1001/jamanetworkopen.2021.11182 ↗
63. Wanga V, Gerdes ME, Shi DS, et al. Characteristics and Clinical Outcomes of Children and Adolescents Aged <18 Years Hospitalized with COVID-19 - Six Hospitals, United States, July-August 2021. *MMWR Morb Mortal Wkly Rep.* Dec 31 2021;70(5152):1766-1772. doi:10.15585/mmwr.mm705152a3
64. Woodruff RC, Campbell AP, Taylor CA, et al. Risk Factors for Severe COVID-19 in Children. *Pediatrics.* 2021;149(1):doi:10.1542/peds.2021-053418 ↗
65. Preston LE, Chevinsky JR, Kompaniyets L, et al. Characteristics and Disease Severity of US Children and Adolescents Diagnosed With COVID-19. *JAMA Netw Open.* Apr 1 2021;4(4):e215298. doi:10.1001/jamanetworkopen.2021.5298 ↗
66. Hobbs CV, Woodworth K, Young CC, et al. Frequency, Characteristics and Complications of COVID-19 in Hospitalized Infants. *Pediatr Infect Dis J.* Mar 1 2022;41(3):e81-e86. doi:10.1097/inf.0000000000003435 ↗
67. Marks KJ, Whitaker M, Agathis NT, et al. Hospitalization of Infants and Children Aged 0-4 Years with Laboratory-Confirmed COVID-19 - COVID-NET, 14 States, March 2020-February 2022. *MMWR Morb Mortal Wkly Rep.* Mar 18 2022;71(11):429-436. doi:10.15585/mmwr.mm7111e2
68. Delahoy MJ, Ujamaa D, Whitaker M, et al. Hospitalizations Associated with COVID-19 Among Children and Adolescents - COVID-NET, 14 States, March 1, 2020-August 14, 2021. *MMWR Morb Mortal Wkly Rep.* Sep 10 2021;70(36):1255-1260. doi:10.15585/mmwr.mm7036e2
69. Siegel DA, Reses HE, Cool AJ, et al. Trends in COVID-19 Cases, Emergency Department Visits, and Hospital Admissions Among Children and Adolescents Aged 0-17 Years - United States, August 2020-August 2021. *MMWR Morb Mortal Wkly Rep.* Sep 10 2021;70(36):1249-1254. doi:10.15585/mmwr.mm7036e1 ↗
70. Marks KJ, Whitaker M, Agathis NT, et al. Hospitalization of Infants and Children Aged 0-4 Years with Laboratory-Confirmed COVID-19 - COVID-NET, 14 States, March 2020-February 2022. *MMWR Morb Mortal Wkly Rep.* Mar 18 2022;71(11):429-436. doi:10.15585/mmwr.mm7111e2
71. Cloete J, Kruger A, Masha M, et al. Paediatric hospitalisations due to COVID-19 during the first SARS-CoV-2 omicron (B.1.1.529) variant wave in South Africa: a multicentre observational study. *The Lancet Child & Adolescent Health.* 2022/05/01/ 2022;6(5):294-302. doi:https://doi.org/10.1016/S2352-4642(22)00027-X ↗
72. Torjesen I. Covid-19: Omicron variant is linked to steep rise in hospital admissions of very young children. *BMJ (Clinical research ed).* 2022;376:o110. doi:10.1136/bmj.o110 ↗
73. Fung M, Babik JM. COVID-19 in Immunocompromised Hosts: What We Know So Far. *Clin Infect Dis.* Jun 27 2020;doi:10.1093/cid/ciaa863 ↗
74. Belsky JA, Tullius BP, Lamb MG, Sayegh R, Stanek JR, Auletta JJ. COVID-19 in immunocompromised patients: A systematic review of cancer, hematopoietic cell and solid organ transplant patients. *Journal of Infection.* 2021/03/01/ 2021;82(3):329-338. doi:https://doi.org/10.1016/j.jinf.2021.01.022 ↗
75. Di Fusco M, Lin J, Vaghela S, et al. COVID-19 vaccine effectiveness among immunocompromised populations: a targeted literature review of real-world studies. *Expert Review of Vaccines.* 2022/04/03 2022;21(4):435-451. doi:10.1080/14760584.2022.2035222 ↗
76. Lee ARYB, Wong SY, Chai LYA, et al. Efficacy of covid-19 vaccines in immunocompromised patients: systematic review and meta-analysis. *BMJ (Clinical research ed).* 2022;376:e068632. doi:10.1136/bmi-2021-068632 ↗

77. Embi PJ, Levy ME, Naleway AL, et al. Effectiveness of two-dose vaccination with mRNA COVID-19 vaccines against COVID-19-associated hospitalizations among immunocompromised adults—Nine States, January–September 2021. *Am J Transplant*. Jan 2022;22(1):306-314. doi:10.1111/ajt.16641
78. Tenforde MW, Patel MM, Gaglani M, et al. Effectiveness of a Third Dose of Pfizer-BioNTech and Moderna Vaccines in Preventing COVID-19 Hospitalization Among Immunocompetent and Immunocompromised Adults - United States, August–December 2021. *MMWR Morb Mortal Wkly Rep*. Jan 28 2022;71(4):118-124. doi:10.15585/mmwr.mm7104a2
79. Kwon JH, Tenforde MW, Gaglani M, et al. mRNA Vaccine Effectiveness Against Coronavirus Disease 2019 Hospitalization Among Solid Organ Transplant Recipients. *The Journal of Infectious Diseases*. 2022;doi:10.1093/infdis/jiac118 ↗
80. Parker EPK, Desai S, Marti M, et al. Response to additional COVID-19 vaccine doses in people who are immunocompromised: a rapid review. *The Lancet Global Health*. 2022/03/01/ 2022;10(3):e326-e328. doi:https://doi.org/10.1016/S2214-109X(21)00593-3 ↗
81. Belay ED, Abrams J, Oster ME, et al. Trends in Geographic and Temporal Distribution of US Children With Multisystem Inflammatory Syndrome During the COVID-19 Pandemic. *JAMA Pediatrics*. 2021;175(8):837-845. doi:10.1001/jamapediatrics.2021.0630 ↗
82. Miller AD, Zambrano LD, Yousaf AR, et al. Multisystem Inflammatory Syndrome in Children—United States, February 2020–July 2021. *Clinical Infectious Diseases*. 2021;doi:10.1093/cid/ciab1007 ↗
83. Feldstein LR, Tenforde MW, Friedman KG, et al. Characteristics and Outcomes of US Children and Adolescents With Multisystem Inflammatory Syndrome in Children (MIS-C) Compared With Severe Acute COVID-19. *Jama*. Mar 16 2021;325(11):1074-1087. doi:10.1001/jama.2021.2091 ↗
84. Godfred-Cato S, Abrams JY, Balachandran N, et al. Distinguishing Multisystem Inflammatory Syndrome in Children From COVID-19, Kawasaki Disease and Toxic Shock Syndrome. *The Pediatric Infectious Disease Journal*. 2022;41(4):315-323. doi:10.1097/inf.0000000000003449 ↗
85. Abrams JY, Belay ED, Godfred-Cato S, et al. Trends in Treatments for Multisystem Inflammatory Syndrome in Children (MIS-C), United States, February 2020 – July 2021. *Clinical Infectious Diseases*. 2022;doi:10.1093/cid/ciac072 ↗
86. Belay ED, Godfred Cato S, Rao AK, et al. Multisystem Inflammatory Syndrome in Adults After Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection and Coronavirus Disease 2019 (COVID-19) Vaccination. *Clinical Infectious Diseases*. 2021;doi:10.1093/cid/ciab936 ↗
87. Patel P, DeCuir J, Abrams J, Campbell AP, Godfred-Cato S, Belay ED. Clinical Characteristics of Multisystem Inflammatory Syndrome in Adults: A Systematic Review. *JAMA Network Open*. 2021;4(9):e2126456-e2126456. doi:10.1001/jamanetworkopen.2021.26456 ↗
88. Hernandez-Romieu AC, Leung S, Mbanya A, et al. Health Care Utilization and Clinical Characteristics of Nonhospitalized Adults in an Integrated Health Care System 28–180 Days After COVID-19 Diagnosis - Georgia, May 2020–March 2021. *MMWR Morb Mortal Wkly Rep*. Apr 30 2021;70(17):644-650. doi:10.15585/mmwr.mm7017e3
89. Chevinsky JR, Tao G, Lavery AM, et al. Late Conditions Diagnosed 1–4 Months Following an Initial Coronavirus Disease 2019 (COVID-19) Encounter: A Matched-Cohort Study Using Inpatient and Outpatient Administrative Data —United States, 1 March–30 June 2020. *Clinical Infectious Diseases*. 2021;73(Supplement_1):S5-S16. doi:10.1093/cid/ciab338 ↗
90. Sudre CH, Murray B, Varsavsky T, et al. Attributes and predictors of long COVID. *Nature Medicine*. 2021/04/01 2021;27(4):626-631. doi:10.1038/s41591-021-01292-y ↗
91. Cohen PA, Hall LE, John JN, Rapoport AB. The Early Natural History of SARS-CoV-2 Infection: Clinical Observations From an Urban, Ambulatory COVID-19 Clinic. *Mayo Clinic proceedings*. 2020/06/01/ 2020;95(6):1124-1126. doi:https://doi.org/10.1016/j.mayocp.2020.04.010 ↗
92. Xie X, Zhong Z, Zhao W, Zheng C, Wang F, Liu J. Chest CT for Typical Coronavirus Disease 2019 (COVID-19) Pneumonia: Relationship to Negative RT-PCR Testing. *Radiology*. 2020/08/01 2020;296(2):E41-E45. doi:10.1148/radiol.2020200343 ↗
93. Daugherty SE, Guo Y, Heath K, et al. Risk of clinical sequelae after the acute phase of SARS-CoV-2 infection: retrospective cohort study. *BMJ (Clinical research ed)*. 2021;373:n1098. doi:10.1136/bmj.n1098 ↗
94. Zimmermann P, Pittet LF, Curtis N. How Common is Long COVID in Children and Adolescents? *Pediatr Infect Dis J*. Dec 1 2021;40(12):e482-e487. doi:10.1097/inf.00000000000003328 ↗

95. Osmanov IM, Spiridonova E, Bobkova P, et al. Risk factors for long covid in previously hospitalised children using the ISARIC Global follow-up protocol: A prospective cohort study. *European Respiratory Journal*. 2021;2101341. doi:10.1183/13993003.01341-2021 ↗
96. Radtke T, Ulyte A, Puhan MA, Kriemler S. Long-term Symptoms After SARS-CoV-2 Infection in Children and Adolescents. *Jama*. Jul 15 2021;326(9):869-71. doi:10.1001/jama.2021.11880 ↗
97. Davis HE, Assaf GS, McCorkell L, et al. Characterizing long COVID in an international cohort: 7 months of symptoms and their impact. *EClinicalMedicine*. 2021/08/01/ 2021;38:101019. doi:<https://doi.org/10.1016/j.eclim.2021.101019> ↗
98. Groff D, Sun A, Ssentongo AE, et al. Short-term and Long-term Rates of Postacute Sequelae of SARS-CoV-2 Infection: A Systematic Review. *JAMA Netw Open*. Oct 1 2021;4(10):e2128568. doi:10.1001/jamanetworkopen.2021.28568 ↗
99. Tillett RL, Sevinsky JR, Hartley PD, et al. Genomic evidence for reinfection with SARS-CoV-2: a case study. *Lancet Infect Dis*. Jan 2021;21(1):52-58. doi:10.1016/S1473-3099(20)30764-7 ↗
100. Wang J, Kaperak C, Sato T, Sakuraba A. COVID-19 reinfection: a rapid systematic review of case reports and case series. *Journal of Investigative Medicine*. 2021;69(6):1253-1255. doi:10.1136/jim-2021-001853 ↗
101. Roskosky M, Borah BF, DeJonge PM, et al. Notes from the Field: SARS-CoV-2 Omicron Variant Infection in 10 Persons Within 90 Days of Previous SARS-CoV-2 Delta Variant Infection - Four States, October 2021-January 2022. *MMWR Morb Mortal Wkly Rep*. Apr 8 2022;71(14):524-526. doi:10.15585/mmwr.mm7114a2
102. Slezak J, Bruxvoort K, Fischer H, Broder B, Ackerson B, Tartof S. Rate and severity of suspected SARS-CoV-2 reinfection in a cohort of PCR-positive COVID-19 patients. *Clinical Microbiology and Infection*. 2021/12/01/ 2021;27(12):1860.e7-1860.e10. doi:<https://doi.org/10.1016/j.cmi.2021.07.030> ↗
103. Abu-Raddad LJ, Chemaitelly H, Bertolini R. Severity of SARS-CoV-2 Reinfections as Compared with Primary Infections. *New England Journal of Medicine*. 2021;385(26):2487-2489. doi:10.1056/NEJMc2108120 ↗
104. Coronavirus (COVID-19) Infection Survey Technical Article: Impact of vaccination on testing positive in the UK: October 2021. <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/coronaviruscovid19infectionssurveylegalarticleimpactoffvaccinationontestingpositiveintheuk/latest> ↗
105. Rössler A, Riepler L, Bante D, von Laer D, Kimpel J. SARS-CoV-2 Omicron Variant Neutralization in Serum from Vaccinated and Convalescent Persons. *New England Journal of Medicine*. 2022;386(7):698-700. doi:10.1056/NEJMc2119236 ↗
106. Leon TM, Dorabawila V, Nelson L, et al. COVID-19 Cases and Hospitalizations by COVID-19 Vaccination Status and Previous COVID-19 Diagnosis - California and New York, May-November 2021. *MMWR Morb Mortal Wkly Rep*. Jan 28 2022;71(4):125-131. doi:10.15585/mmwr.mm7104e1
107. Cavanaugh AM, Spicer KB, Thoroughman D, Glick C, Winter K. Reduced Risk of Reinfection with SARS-CoV-2 After COVID-19 Vaccination - Kentucky, May-June 2021. *MMWR Morb Mortal Wkly Rep*. Aug 13 2021;70(32):1081-1083. doi:10.15585/mmwr.mm7032e1